(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

AO

(11) Publication number: **0 298 442 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication of patent specification: **01.04.92**

(51) Int. Cl.^{5}: **F04D 9/00**, F04D 29/70

(21) Application number: **88110778.3**

(22) Date of filing: **06.07.88**

(54) A pump and a method of separating gas by such from a fluid to be pumped.

(30) Priority: **06.07.87 FI 872967**

(43) Date of publication of application:
11.01.89 Bulletin 89/02

(45) Publication of the grant of the patent:
01.04.92 Bulletin 92/14

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(56) References cited:
DE-A- 2 312 022
DE-C- 858 357
DE-C- 864 953
NL-C- 80 028
US-A- 3 435 771
US-A- 4 194 893
DE-B- 1 023 671
DE-C- 862 563
FR-A- 456 863
US-A- 1 345 895
US-A- 3 944 406

(73) Proprietor: **A. AHLSTROM CORPORATION**
SF-29600 Noormarkku(FI)

(72) Inventor: **Niskanen, Toivo**
Maariankatu 10B 18
SF-49400 Hamina(FI)

(74) Representative: **Füchsle, Klaus, Dipl.-Ing. et al**
Hoffmann . Eitle & Partner Patentanwälte Arabellastrasse 4
W-8000 München 81(DE)

EP 0 298 442 B1

Description

The present invention relates to a pump for separating gas from a fluid to be pumped. More specifically, the invention relates to a gas discharge system of a pump used for pumping of a fluid containing gas. The pump according to the invention is especially suitable for pumping fiber suspensions of the pulp and paper industry.

It is well known that pumping of fluids containing gases, with higher gas contents, is unsuccessful without a gas discharge system because the gases concentrate around the center of the pump rotor, forming a bubble which grows thus tending to clog the entire inlet opening of the pump. This results in a considerable fall of the yield, vibration of the equipment, and in the worst case stopping of the pumping altogether. This problem has been experienced in a very difficult form with, for example, centrifugal pumps.

These problems have been attempted to be solved in many different ways by discharging gas from the bubble. In the equipment presently known and used, degasification is effected by either drawing gas through a pipe being disposed in the middle of the inlet opening of the pump and extending to the hub of the impeller, by drawing gas through a hollow shaft of the impeller, as known from DE-C-862563, or by providing the impeller with one or more perforations through which the gas is drawn to the back side of the impeller and further away, as known from DE-B-1023671.

All above means function satisfactorily if the fluid is clean. Problems arise when the fluid contains foreign matter such as fibers, threads etc. In such a case, these contaminants tend to clog the gas discharge ducts, the staying open of which is a matter of necessity for the operation of the pump.

Several different arrangements are known by means of which it has been tried to eliminate or minimize the disadvantages or risks caused by contaminants. The simplest arrangement is a gas discharge duct which is so wide that clogging is out or the question. Other methods used are, for example, arrangements with various types of vanes or vaned rotors on the back side of the impeller. A commonly used method such as disclosed in DE-B-1023671 has been such that the immediate back surface of the impeller has been provided with radial vanes which are intended for pumping the fluid with its contaminants, which fluid has been carried with the gas through the gas discharge openings of the impeller, to the outer periphery of the impeller and through its clearance back to the liquid flow. In some cases, a similar type arrangement has been provided farther on the back side of the impeller by means or a vaned rotor mounted on the shaft of the impeller. Said vaned rotor rotates in a chamber of its own, being apt to separate the liquid, which has been carried with the gas, to the outer periphery of the chamber, whereby the gas can be further drawn to the inner periphery. The fluid accumulated on the outer periphery of the chamber is led, together with its contaminants, through a separate duct to either the inlet side or the outlet side of the pump.

All means described above operate satisfactorily if the amount of contaminants being carried with the liquid is restricted. It is also possible to adjust said means to operate relatively reliably with liquids that contain plenty of solids, e.g. with fiber suspensions in the pulp industry. In that case, however, it has to be compromised over the property of gas discharging because the most important thing is to secure that no fibers are conveyed to the gas discharge duct. Thus, fiber suspension containing gas has to be returned back to the flow. On the other hand, it is known that the gas contained in the fiber suspension is a drawback in the stock preparation process, which drawback should as much as possible be avoided. Therefore, it is wasting of existing advantages to feed the gas that has already been separated back to the stock circulation. It is also wasting of stock if, on the other had, all stock conveyed along with the gas were separated from the stock circulation by discharging it as a secondary flow of the pump.

The object of the invention is to make full advantage of the capability of the centrifugal pump of separating gas from liquid with no risk of foreign matter, i.e. solids such as wires, fibers etc. which flow along with the liquid, from clogging the gas discharge ducts.

This object is solved in accordance with the present invention by a centrifugal pump having the features according to claim 1 or 2. Additionally, this object is solved in accordance with the present invention by a centrifugal pump according to claim 9.

Advantages of the centrifugal pump according to the invention over existing arrangements are, for example, the following:

- more efficient gas discharge because the liquid containing gas need not be returned to the main circulation,
- pumping of fiber suspensions involves no risk of the gas discharge ducts becoming clogged or fiber suspension becoming wasted or being led to waste waters,
- furthermore, there is no such risk that the pressure of the pumped material would force contaminants to the gas discharge ducts when the pump is in a standstill, which is quite common with equipment provided with a conventional gas discharge arrangement.

The apparatus of the invention is further de-

scribed in greater detail with reference to the accompanying drawings, in which

- Fig. 1 illustrates a conventional centrifugal pump provided with an improvement according to the invention,
- Fig. 2 illustrates a preferred embodiment of the arrangement according to the invention,
- Fig. 3 illustrates a second preferred embodiment,
- Fig. 4 illustrates a third preferred embodiment, and
- Fig. 5 illustrates a fourth preferred embodiment.

Fig. 1 illustrates a conventional centrifugal pump comprising a casing 1 with an inlet opening 2 and with an outlet opening 3, a body 4 and a shaft 5 with an impeller 6. The shaft 5 is mounted on bearings 7 to the body 4 which body is also provided with a gas discharge duct 8 originating from a chamber 9 which surrounds the shaft 5. The chamber 9 has a connection to the impeller 6, which is provided with a hole/holes 10 for leading gas from the front side of the impeller to the back side thereof to a space 11. The back surface of the impeller 6 is provided with vanes 12, which most commonly are radial but which may also be curved or be disposed on a plane not extending through the shaft, as it will appear later.

As shown in Fig. 1, there is a wall 13 disposed between the chamber 9 and the space 11, which wall is formed of a screen plate provided with small holes or slots and which is intended for preventing the foreign matter contained in the liquid treated by the pump from entering the gas discharge duct 8. When a centrifugal pump is used for pumping pulp suspensions in the pulp industry, the perforation diameter or the slot width of the screen plate has to be very small. Tests have indicated that the above-mentioned dimensions have to be appr. 0.2 mm in order to prevent substantial penetration of the fibers of the pulp suspension into the screen plate. In such a construction, however, the vanes 12 of the impeller 6, apart from the pumping task described with the prior art equipment, also have another task i.e. keeping the screen plate clean. When the clearance between the vanes 12 and screen plate 13 is made sufficiently small, for example, about 1 mm, the vanes wipe all perforations of the screen plate making them clear. To be more specific, the vanes 12 create such a heavy turbulence onto the surface of the screen plate as to provide no time at all for the fibers to stick to the perforations of the screen plate.

Said turbulence development and clearing the screen plate perforations may be further intensified by screen plate arrangements 20 and 30 in accordance with Figs. 2 and 3, in which arrangements the perforations 21 and 31 are disposed in the bottom of the grooves 22 and 32 machined to the screen plate. In Fig. 2, the grooves 22 are radial or deviate only a little from the radial direction. In this case the back vanes 12 of the impeller may correspondingly be radial or slightly deviate from said direction. The direction of the vanes need not, however, be the same as that of the grooves 22.

In Fig. 3, the perforations 31 of the perforated plate 30 are disposed in the bottom of the grooves 32, just as in the previous embodiment. The grooves 32 are, however, annular, and are therefore easy to make, for example, by turning in a lathe. The grooves may naturally also be spiral-formed. In these cases, a different impeller 6 is necessary. To be more specific, the back vanes 12 of the impeller should deviate from the radial direction because otherwise a desired pressure pulse cannot be generated for clearing the grooves and perforations. Preferably, the back vanes 12 are curved so as to throw the liquid entered the space 11 vigorously outwards. Hereby, they also create a pressure pulse adequate to separate the fibers carried with the liquid from the perforations 31 in the grooves 32. In some cases, it is recommendable to use a ceramic screen surface which covers the openings machined in the impeller. In such a case, the gas discharge is facilitated through the pores in the surface whereas the solids cannot penetrate them.

A further embodiment is such that a screen surface corresponding to a screen plate is arranged to directly replace the perforations of the impeller. In that case, it is obvious that there has to be a great number of perforations and that they have to be sufficiently small in diameter. A preferred hole size is less than 0.5 mm in general and in some cases there is reason to provide a perforation diameter of 0.2 mm or even less.

Fig. 4 illustrates an embodiment with a screen surface 40 being disposed inside the back vanes 12 of the impeller 6. In this case the screen surface comprises a cylindrical surface, which may be also grooved either axially or spirally. Preferably the screen surface is disposed so close to the shaft-side edge of the vanes 12 that said vanes 12 keep the screen surface clear. From the space between the screen surface 40 and the shaft the gas is led to the gas discharge duct 8 just as in the previous embodiments.

Fig. 5 illustrates an embodiment in which the gas discharge is not effected through the impeller 6 but already before it. As is known, a gas bubble is formed in the pump in front of the impeller, in the center of the inlet opening, whereby it is preferable to remove the gas until the bubble has grown so big that it will extend to the impeller. In the arrangement according to the invention, in front of the impeller, around the shaft line is disposed a

member 50, which has preferably been made by bending a screen plate to a cylindrical form and by closing its one end with either a blind plate or a screen plate 51. In the embodiment as shown in Fig. 5, the member 50 is attached at its one end to a shaft 55, inside of which shaft has been drilled a duct 52 for leading gas to the gas discharge duct 8. There are naturally also other ways of discharging gas from the member 50. For example, an axial pipe may be provided from the end 51 of the member 50 in the opposite direction, which on the other hand is a more complicated arrangement but possible anyway. Furthermore, Fig. 5 illustrates a fluidizing rotor 53 disposed in the inlet opening 2, the inner edge of the blades of which rotor extends so near to the screen surface of the member 50 that said surface stays clean especially if the side of the member 50 opposite to the shaft is attached unrotatably or to be separately rotatable along with the rest of the apparatus disposed on the front side of the pump. Staying clean may be further secured by providing the screen surface of the member 50 with axial or spiral-formed grooves 54 the object of which grooves is, together with the blades of the rotor 53, to generate pulses which prevent the solid particles that are carried with the fluid to be pumped from adhering to the perforations of the screen surface.

The screen surfaces may naturally be disposed in several other places as well. For example, vanes 12 on the back side of the impeller may be utilized, to the edge of which vanes, which edge is opposite to the impeller may be attached a screen surface in the radial direction. The screen surface may also be arranged on that edge of the vanes 12 which is nearest to the shaft 5 and said screen surface may be similar in shape to the axial cylinder or part thereof. In these cases, the screen surface cannot be wiped clear directly by mechanical members, but pulse members arranged in the body construction of the pump have to be used, two or three of such members being disposed at regular intervals on the body section nearest to the screen surface. These members direct a heavy pressure pulse against the screen surface, which pulse forces the dry substance possibly stuck in the perforations, slots or pores of the screen surface back to the space between the vanes 12, wherefrom the vanes return it to the fluid circulation.

As it appears from the above description, by the developed pump constructon according to the invention the problems of prior art are avoided. The basic idea of the arrangement has been to remove gas through the screen surface, by means of which screen surface it is possible to prevent solid particles that are carried with the fluid to be pumped from entering the gas discharge duct or even the space wherefrom gas is taken into said duct. In all previous arrangements, perforations with such a wide diameter have been used that solid particles have easily flown through the perforations. Especially, in pumping high-consistency fiber suspensions gradual clogging of the gas discharge ducting has constituted a problem, said clogging being caused by accumulation of pulp fibers into large fiber bundles.

For this reason, it has been necessary to use a vacuum pump separate with regard to the pump itself, by means of which vacuum pump the gas has been drawn out of the gas discharge system. In this case, if the gas discharge ducts have become clogged, it has been possible to clear the ducts by detaching the pipe which connects the vacuum pump to the gas discharge duct and thereafter to clean the duct. Connecting the vacuum pump itself to the main pump has been out of the question because solids being carried with the gas would have damaged the vacuum pump or clogged it altogether in the long run, and the result of both cases would have been a complicated repair work involving the dismantling of the entire pump. In some operational situations it is also possible that the centrifugal pump becomes clogged i.e. becomes filled with high-consistency pulp, in which case the centrifugal pump itself can usually be fixed for operation by using dilution, but the vacuum pump used for deaeration cannot, even if dilution were directed to it, be made to rotate but it has to be dismantled. If the vacuum pump is mounted on the shaft of the centrifugal pump, dismantling is rather awkward. Thus, a separate vacuum pump with a drive motor has added to the costs of constructions, which has been one of the obstacles to a wider acceptance of a centrifugal pump for stock handling. The present invention, however, facilitates the attachment of the vacuum pump direct to the shaft of the centrifugal pump with no separate drive motor for the vacuum pump because it has been secured that no solids can enter the vacuum pump along with the gas.

Finally, there is reason to remember that the above description discloses only a few preferred embodiments of the pump arrangement according to the invention, the protective scope of which invention is not limited to the above but to what is disclosed in the accompanying claims. Therefore, it has to be noted that all kinds of surfaces provided with holes, slots, pores or other equivalent perforations are applicable. It is also possible to use, similarly to a screen, a surface with bigger perforations to which a thin, felt-like fiber mat is allowed to be formed, said fiber mat preventing the solids from getting to the gas discharge system. In this case, the thickness of the fiber mat may be adjusted by, for example, a mechanical adjusting element which allows thickening of the fiber mat to

a certain dimension but wipes an extra fiber layer off. Hence, the above term "screen surface" shall not be understood in a narrow sense but in terms of covering a great many arrangements. The basic object of the whole surface is to separate coarser material from a fluid to be pumped, whereby the solids contained in these fluids as well as the properties of said solids only determine the type and more detailed construction of the screen surface. Furthermore, it is worth noticing that the apparatus according to the invention is applicable to all pumps and equivalent means in which gas is separated during the treatment.

Claims

1. Centrifugal pump for treating fiber suspensions, comprising a casing (1) having an inlet (2) and an outlet (3), a shaft (5) upon which an impeller (6) is mounted, the impeller (6) being provided with rear vanes (12) and openings (10) for allowing a gas to flow to the rear side thereof, and a pump body (4) provided with a gas discharge duct (8),
characterized in that a screen surface (13, 20, 30) is arranged in the rear wall of the pump body (4) between the gas discharge duct (8) and the rear vanes (12), and that the screen surface (13, 20, 30) is grooved on its side facing the rear vanes (12), wherein at least some of the perforations (21, 31) provided in the screen surface (13, 20, 30) disposed in the grooves (22, 32).

2. Centrifugal pump for treating fiber suspensions, comprising a casing (1) having an inlet (2) and an outlet (3), a shaft (5) upon which an impeller (6) is mounted, the impeller (6) being provided with rear vanes (12) and openings (10) for allowing a gas to flow to the rear side thereof, and a pump body (4) provided with a gas discharge duct (8),
characterized in that a screen surface (40) is arranged on the rear vanes (12) of the impeller (6), that the pump body (4) is provided with members between the rear vanes (12) and the gas discharge duct (8) which are disposed close to the screen surface (40), and that the screen surface (40) is grooved on its side facing the members, whereby at least some of the perforations provided in the screen surface (40) are disposed in the grooves.

3. Centrifugal pump according to claim 1 or 2, **characterized** in that the gas discharge passages, from the front side of the impeller (6) to the gas discharge duct (8), are provided with at least one additional screen surface.

4. Centrifugal pump according to claim 1 or 2, **characterized** in that the openings (10) in the impeller (6) are so small in size that they themselves form a screen surface.

5. Centrifugal pump according to claim 1, **characterized** in that the screen surface (13, 20, 30) protrudes from the rear wall of the pump body (4) radially towards the shaft (5).

6. Centrifugal pump according to claim 1, **characterized** in that the screen surface (13, 20, 30) protrudes from the rear wall of the pump axially towards the impeller (6).

7. Centrifugal pump according to claim 2, **characterized** in that the screen surface (40) is provided on the rear vane (12) edges opposite to the impeller (6).

8. Centrifugal pump according to claim 2, **characterized** in that the screen surface (40) is provided on the rear vane (12) edges nearest to the shaft (5).

9. Centrifugal pump for treating fiber suspensions, comprising a casing (1) having an inlet (2) and an outlet (3), a hollow shaft (55) upon which an impeller (6) is mounted, a fluidizing rotor (53) provided in front of the impeller (6), a pump body (4) provided with a gas discharge duct (8) connected to the hollow shaft (55), and a member (50) provided with a screen surface disposed around the shaft (55) in the vicinity of the rotor surface, **characterized** in that the screen surface is grooved on its side facing the inner edges of the blades of the rotor (53), whereby at least some of the perforations provided in the screen surface are disposed in the grooves (54).

10. Centrifugal pump according to claim 1, **characterized** in that the grooves (22) in the screen surface (20) are provided radially thereon.

11. Centrifugal pump according to claim 1, 2 or 9, **characterized** in that the grooves (32) in the screen surface (30; 40) are provided annularly thereon.

12. Centrifugal pump according to claim 1, 2 or 9, **characterized** in that the grooves (22; 32; 54) in the screen surface (13, 20, 30; 40) are provided spirally thereon.

13. Centrifugal pump according to claims 1, 2 or 9, **characteriz d** in that a vacuum pump is pro-

vided on the shaft (5; 55) between the screen surface (13, 20, 30; 40) and the gas discharge duct (8).

Revendications

1. Pompe centrifuge pour traiter des suspensions de fibres, comprenant un logement (1) comportant une entrée (2) et une sortie (3),
un arbre (5) sur lequel une hélice (6) est montée, l'hélice (6) étant munie de palettes arrière (12) et d'ouvertures (10) pour permettre à un gaz de s'écouler vers son côté arrière, et un corps de pompe (4) munie d'une conduite d'évacuation de gaz (8),
caractérisée en ce qu 'une surface perforée (13, 20,30) est disposée dans la paroi arrière du corps de la pompe (4) entre la conduite d'évacuation de gaz (8) et les palettes arrière (12), et en ce que la surface perforée (13, 20, 30) est rainurée sur son côté faisant face aux palettes arrière (12), dans laquelle quelques perforations au moins (21, 31) prévues dans la surface perforée (13, 20, 30) sont disposées dans les rainures (22, 32).

2. Pompe centrifuge pour traiter des suspensions de fibres, comprenant un logement (1) comportant une entrée (2) et une sortie (3),
un arbre (5) sur lequel une hélice (6) est montée, l'hélice (6) étant munie de palettes arrière (12) et d'ouvertures (10) pour permettre à un gaz de s'écouler vers son côté arrière,
et un corps de pompe (4) munie d'une conduite d'évacuation de gaz (8),
caractérisée en ce qu'une surface perforée (40) est disposée sur les palettes arrière (12) de l'hélice (6), en ce que le corps de pompe (4) est muni d élements entre les palettes arrière (12) et la conduite d'évacuation de gaz (8) qui sont disposés près de la surface perforée (40),
et en ce que la surface perforée (40) est rainurée sur son côté faisant face aux éléments, de façon a ce qu'au moins quelques perforations prévues dans la surface perforée (40) soient disposées dans les rainures.

3. Pompe centrifuge selon la revendication 1 ou 2, caractérisée en ce que les passages d'évacuation de gaz, du côté avant de l'hélice (6) à la conduite d évacuation de gaz (8), sont munis d'au moins une surface perforée supplémentaire.

4. Pompe centrifuge selon la revendication 1 ou 2, caractérisée en ce que les ouvertures (10) dans l'hélice (6) sont de dimensions si petites qu'elles peuvent former elles-mêmes une surface perforée.

5. Pompe centrifuge selon la revendication 1, caractérisée en ce que la surface perforée (13, 20, 30) fait saillie à partir de la paroi arrière du corps de pompe (4) radialement vers l'arbre (5).

6. Pompe centrifuge selon la revendication 1, caractérisée en ce que la surface perforée (13, 20, 30) fait saillie depuis la paroi arrière de la pompe axialement vers l'hélice (6).

7. Pompe centrifuge selon la revendication 2, caractérisée en ce que la surface perforée (40) est prévue sur les bords des palettes arrière (12) opposés à l'hélice (6).

8. Pompe centrifuge selon la revendication 2, caractérisée en ce que la surface perforée (40) est prévue sur les bords des palettes arrière (12) les plus proches de l'arbre (5).

9. Pompe centrifuge pour traiter des suspensions de fibres, comprenant un logement (1) comportant une entrée (2) et une sortie (3) un arbre creux (55) sur lequel une hélice (6) est montée, un rotor de fluidisation (53) prévu en face de l'hélice (6), un corps de pompe (4) muni d'une conduite d'évacuation de gaz (8) connectée à l'arbre creux (55), et un élément (50) muni d'une surface perforée disposée autour de l'arbre (55) au voisinage de la surface du rotor, caractérisée en ce que la surface perforée est rainurée sur son côté faisant face aux bords intérieurs des ailettes du rotor (53), de façon à ce qu'au moins quelques unes des perforations prévues dans la surface perforée soient disposées dans les rainures (54).

10. Pompe centrifuge selon la revendication 1, caractérisée en ce que les rainures (22) dans la surface perforée (20) sont prévues radialement sur elle.

11. Pompe centrifuge selon la revendication 1, 2 ou 9, caractérisée en ce que les rainures (32) dans la surface perforée (30 ; 40) sont prévues sur elle de façon annulaire.

12. Pompe centrifuge selon les revendications 1, 2 ou 9, caractérisée en ce que les rainures (22; 32; 54) dans la surface perforée (13,20, 30 ; 40) sont prévues sur elle en spirale.

13. Pompe centrifuge selon les revendications 1, 2 ou 9, caractérisée en ce que une pompe à

vide est prévue sur l'arbre (5,55) entre la surface perforée (13, 20, 30,40) et la conduite d'évacuation de gaz (8).

Patentansprüche

1. Kreiselpumpe zur Behandlung von Fasersuspensionen, bestehend aus einem Gehäuse (1) mit einem Zulauf (2) und einem Ablauf (3), einer Welle (5), auf der ein Laufrad (6) montiert ist, welches Laufrad (6) mit hinteren Schaufeln (12) und Öffnungen (10) versehen ist, um zu ermöglichen, daß Gas auf dessen Rückseite fließen kann, und einem Pumpenkörper (4), der mit einem Gasabzugskanal (8) ausgestattet ist, dadurch gekennzeichnet, daß in der Rückwand des Pumpenkörpers (4) zwischendem Gasabzugskanal (8) und den hinteren Schaufeln (12) eine Siebfläche (13, 20, 30) angeordnet ist, und daß die Siebfläche (13, 20, 30) auf ihrer den hinteren Schaufeln (12) zugewandten Seite gerillt ist, wobei mindestens einige der in der Siebfläche vorgesehenen Perforationen (21, 31) in den Rillen angeordnet sind.

2. Kreiselpumpe zur Behandlung von Fasersuspensionen, bestehend aus einem Gehäuse (1) mit einem Zulauf (2) und einem Ablauf (3), einer Welle (5), auf der ein Laufrad (6) montiert ist, welches Laufrad (6) mit hinteren Schaufeln (12) und Öffnungen (10) versehen ist, um zu ermöglichen, daß Gas auf dessen Rückseite fließen kann, und einem Pumpenkörper (4), der mit einem Gasabzugskanal (8) ausgestattet ist, dadurch gekennzeichnet, daß eine Siebfläche (40) auf den hinteren Schaufeln (12) des Laufrads (6) arrangiert ist, daß der Pumpenkörper (4) zwischen den hinteren Schaufeln (12) und dem Gasabzugskanal (8) mit Organen versehen ist, die dicht an der Siebfläche (40) positioniert sind, und daß die Siebfläche (40) auf ihrer den hinteren Organen zugewandten Seite gerillt ist, wobei mindestens einige der inder Siebfläche (40) vorgesehenen Perforationen in den Rillen angeordnet sind.

3. Kreiselpumpe gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Gasabzugskanäle von der Vorderseite des Laufrads (6) zum Gasabzugskanal (8) mit mindestens einer zusätzlichen Siebfläche versehen sind.

4. Kreiselpumpe gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Öffnungen (10) des Laufrads (6) vom Durchmesser her so klein sind, daß sie als solche eine Siebfläche bilden.

5. Kreiselpumpe gemäß Anspruch 1, dadurch gekennzeichnet, daß die Siebfläche (13, 20, 30,) von der Rückwand des Pumpenkörpers radial zur Welle (5) hin vorspringt.

6. Kreiselpumpe gemäß Anspruch 1, dadurch gekennzeichnet, daß die Siebfläche (13, 20, 30) von der Rückwand des Pumpenkörpers (4) axial zum Laufrad (6) hin vorspringt.

7. Kreiselpumpe gemäß Anspruch 2, dadurch gekennzeichnet, daß die Siebfläche (40) auf den zum Laufrad (6) gegenüberliegenden Kanten der hinteren Schaufeln (12) vorgesehen ist.

8. Kreiselpumpe gemäß Anspruch 2, dadurch gekennzeichnet, daß die Siebfläche (40) auf den zur Welle (5) am nächsten liegenden Kanten der hinteren Schaufeln (12) vorgesehen ist.

9. Kreiselpumpe zur Behandlung von Fasersuspensionen, bestehend aus einem Gehäuse (1) mit einem Zulauf (2) und einem Ablauf (3), einer Hohlwelle (55), auf der ein Laufrad (6) montiert ist, einem vor dem dem Laufrad (6) angeordneten Fluidisierungsläufer (53), einem Pumpenkörper (4) versehen mit einem Gasabzugskanal (8), der mit der Hohlwelle (55) verbunden ist, und einem mit einer Siebfläche ausgestattetem Glied (50), das um die Welle (55) herum in der Nähe der Läuferoberfläche angeordnet ist, dadurch gekennzeichnet, daß die Siebfläche auf ihrer den Innenkanten der Schaufeln des Läufers (53) zugewandten Seite gerillt ist, wobei mindestens einige der in der Siebfläche vorgesehen Perforationen in den Rillen (54) angeordnet sind.

10. Kreiselpumpe gemäß Anspruch 1, dadurch gekennzeichnet, daß die Rillen (22) in der Siebfläche (20) radial darauf vorgesehen sind.

11. Kreiselpumpe gemäß Anspruch 1, 2 oder 9, dadurch gekennzeichnet, daß die Rillen (32) in der Siebfläche (30; 40) ringförmig darauf angeordnet sind.

12. Kreiselpumpe gemäß Anspruch 1, 2 oder 9, dadurch gekennzeichnet, daß die Rillen (22; 32; 54) in der Siebfläche (13, 20, 30; 40) spiralförmig darauf angeordnet sind.

13. Kreiselpumpe gemäß Anspruch 1, 2 oder 9, dadurch gekennzeichnet, daß auf der Welle (5; 55) zwischen der Siebfläche (13, 20; 30; 40) und dem Gasabzugskanal (8) eine Vakuumpumpe vorgesehen ist.

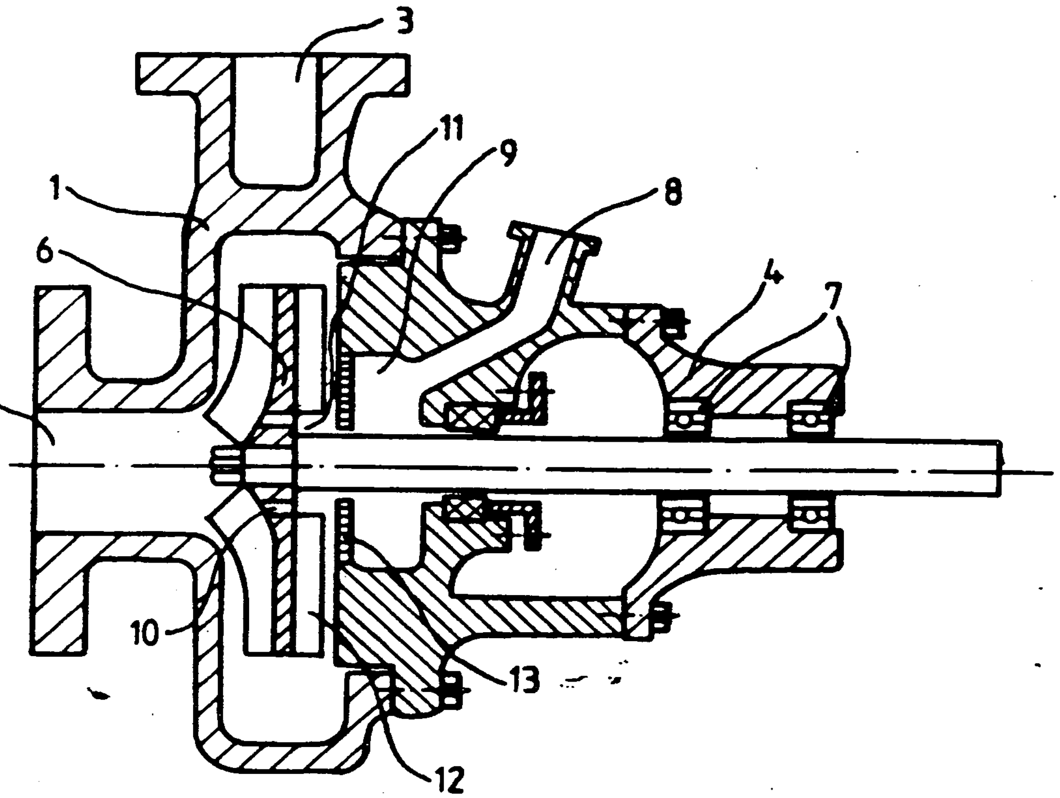

FIG. 1

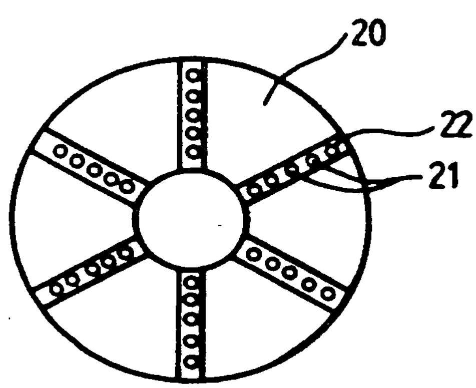

FIG. 2

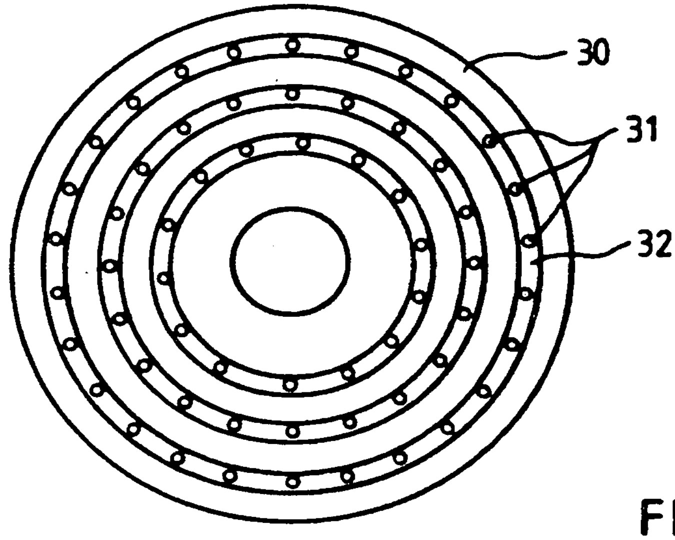

FIG. 3

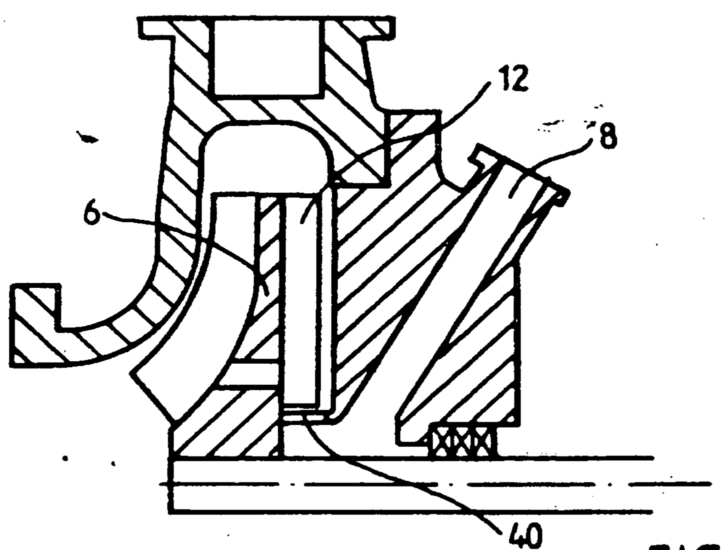

FIG. 4

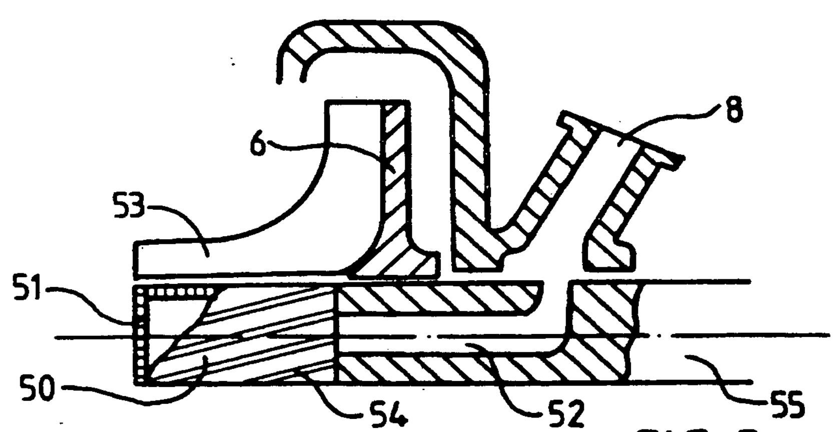

FIG. 5

THIS PAGE BLANK (USPTO)